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Comparative Study of Factors Leading to Detrimental Variations in Public Building Projects

Yusuph Mhando[1*], Ramadhan Mlinga[2], Henry Alinaitwe[1]

1. School of the Built Environment, Makerere University, P. O. Box 7062, Kampala, Uganda
2. College of Engineering, University of Dar es Salaam, P. O. Box 35131, Dar es Salaam, Tanzania

* E-mail of the corresponding author: ybmhando@gmail.com

Abstract

Variations with their attached effects on construction projects continue to be a chronic problem worldwide and the situation is getting worse. Many public building projects, particularly in developing countries have been subjected to detrimental variations often leading to cost overruns, time overruns, project abandonment, rework, disruption and conflicts. Consequently, these have led to non-fulfillment of project objectives. Relative to their geographical locations in East African (EA), the economies of Tanzania (TZ) and Uganda (UG) mainly depend on agriculture and almost have similar characteristics and investment in the construction sector. This study was aimed at identifying, evaluating and comparing the causes of detrimental variations in public building projects in Tanzania and Uganda. This could help in monitoring the trends of deleterious variations and safeguarding the anticipated value for money in such building projects. Pertinent literature was reviewed coupled with structured questionnaire administered to 183 professionals in Tanzania to elicit relevant information with regard to causes of detrimental variations. Nevertheless, 143 responses were received constituting 78 percent response rate. Relatively, the study in Uganda used structured questionnaire administered to 54 professionals with 34 responses constituting 65.4 percent response rate. Statistical analysis such as frequencies, coefficient of variations (COV), Cronbach's alpha reliability test and t-test were used to analyse and syntheses data collected from questionnaires. Subsequently, the causes of detrimental variation variables were ranked according to their importance and occurrence. The agreement among respondents in rating and ranking the factors of detrimental variations was found to be significant. Findings suggest the top five highly ranked factors of detrimental variations in both countries as change of plan or scope by client, design discrepancies by consultant, lack of judgement and experience by contractor, weather conditions and change in economic conditions. These factors significantly contribute detrimental effects to construction projects performance, thus jeopardizing the integrity of the construction industry. The study findings should help policy makers, construction practitioners, researchers and academicians to improve construction performance.

Keywords: Causes, Detrimental, Public building projects, Tanzania, Uganda, Variations

1. Introduction

Variations with their attached effects on construction projects continue to be a chronic problem worldwide and the situation is getting worse. However, the situation is dire in developing countries, with the consequence of stagnated economic development (Ismail et al., 2012). Detrimental variations may result into complexity with the consequence of negative impacts on the construction project performance in terms of time, cost and quality. Great concern has been expressed in recent years regarding the adverse impacts of variations in public building projects in Tanzania. Arguably, this is because such projects are implemented by using meager public resources of which to the great extent come from tax payers' money. Under normal circumstances one would expect the project to be completed within the initially anticipated cost, time and quality, but reality takes the opposite direction. As a result of adverse effects of variations, many cases of poor quality, late completion and cost overruns are being reported in many construction projects in Tanzania and some of these projects have not been successfully implemented as expected (Mlinga, 2008).

Entrusty Group (2008) defines variation as a change, modification, alteration, revision or amendment to the original intent of the contract and / or its works. It may involve the alteration of kind or standard of any materials to be used in the works (Nachatar et al., 2010). To date, several studies have been carried out on the causes and effects of variations in construction projects delivery (Priyantha et al., 2011). However, most of these researches were too general with little attention on public building projects. In addition, these researches have inadequately investigated the major causes of detrimental variations in construction projects. Such studies include Senaratne and Sexton (2008) that contributed to theory and knowledge-based project change process; Ndihokubwayo and

Haupt (2009) found that variation orders were not realistically priced resulting in an increased construction costs. Others are Mohammad et al. (2010) and Memon et al. (2014) who managed to outline few causes of variations in Malaysia which inevitably fuel the need to look comparatively the experiences of variations in other countries. Moreover, Kassim and Long (2007) reveal that few formal studies have been carried out to analyse the causes and effects of variations in construction projects. Hence, this study intends to fill that lacunae and heed Kassim and Long (2007) plea for pioneers to carry extensive study on the causes of detrimental variations in construction projects.

This study was about to identify and evaluate the major causes of detrimental variations in public building projects in Tanzania (TZ) and Uganda (UG) and compare the results. Relative to their geographical locations in East Africa (EA), the economies of both countries most depend on agriculture and almost have similar characteristics and investment in the construction sector. Findings could help in monitoring the trends of detrimental variations and identifying areas of improvement to safeguard the anticipated value for money in such building projects. Pertinent literature was reviewed coupled with structured questionnaire administered to construction professionals to obtain views with regard to factors of variations. The statistical analysis was used to analyse and syntheses data. The major causes of variations were identified, evaluated and ranked according to their importance and occurrence. Results from this study should help policy makers, construction practitioners, researchers and academicians to improve construction performance. The rest of the article is organised as follows: first, the literature on variations and their causes were reviewed. This is followed by a description of research methods and data analysis techniques used for the study. Results of the study are then discussed. The paper concludes with discussion of practical, theoretical and managerial implications and directions for future research.

2. Literature Review

2.1 Profile of Tanzania Construction Industry

Tanzania construction industry contributes approximately 5-10 percent of the country's Gross Domestic Product (GDP) and 50-65 percent of the Gross Fixed Capital Formation (GFCF). Wuyts and Kilama (2014) found that in 2010 the construction sector contributed 8 percent of the country's GDP. Contractors' Registration Board (CRB) of Tanzania (2011) affirms that the construction value of capital formation was 50 percent in the year 2010. Apparently, the significant portion of the government's development budget (about 60 percent) is spent on construction projects. National Bureau of Statistics (NBS) (2016) affirms that construction activities grew faster than other activities in the year 2015 at 16.8 percent. This growth is mainly attributed to continued Government investment in infrastructure development. Additionally, the economic reforms carried out during the past decade have attracted a significant increase in donor, private sector and foreign direct investments in infrastructure developments. Moreover, the amount of manpower employed by the construction sector is about 9 percent of the work force in Tanzania (CRB, 2011).

2.2 Profile of Uganda Construction Industry

Relatively, the construction industry in Uganda contributes approximately 12 percent of the Gross Domestic Product (GDP) and makes a significant contribution to the economy (Alinaitwe et al., 2013). The construction sector also employs more than 50 percent of the non-farm workers in Uganda (Alinaitwe et al., 2013). Moreover, the construction sector in Uganda is said to be the second largest source of employment after agriculture. The Ugandan Bureau of Statistics (UBoS) report of 2011 indicates that more than 45 percent of the 2011/2012 budget could be spent on construction-related activities (Alinaitwe et al., 2013). Arguably, the construction sector is among the very important sectors that contribute hugely to the Gross Domestic Product (GDP) of that particular country. This signifies that construction sector plays a big role in supporting the country's economic growth, further development and sustenance of physical infrastructure.

2.3 The Concept of Variations in Construction

Variation is defined as the change, modification, alteration, revision or amendment to the original intent of the contract and /or its works (Entrusty Group, 2008). It may involve the alteration of kind or standard of any materials to be used in the works (Nachatar et al., 2010). Moreover, it is an area of research in the construction industry that still needs to be researched, as it has received limited attention. Hao et al. (2008) insist that there is a very limited research work addressing the change management issues specifically within the construction

project management context. Variation of project scope, political factor, wrong estimate and faulty design may cause abandonment of construction project, resulting in wastage of government resources (Olusegun and Michael, 2011). Likewise, dubious payments by procurement entities to contactors due to non-contractual payments, repetition of work items, premature payment of preliminary items, unjustified variation orders, overpayments due to wrong assumptions, and paying for non-existing works are the relevant sources of detrimental variations in public building projects. It is therefore clear that construction work processes might have many unpredictable variations such that their minimization is necessary. Thus, project management team must have knowledge, skills and abilities to deal with the day-to-day management challenges of changes (Zadeh et al., 2016).

2.4 Causes of Variations

Causes of variations may originate from external and internal issues that may occur during the development phases of projects from basic design to construction (Erdogan et al., 2005; Moghaddam, 2012). Variations originating from internal issues are those from the project organisation which involve clients, consultants and contractors. This implies that, key players in a building project have a big role to play in ensuring that variations are controlled to generate good value for money. Murdoch and Hughes (2008) insist that variations may originate from three ways: (i) clients may change their minds about what they asked for before the work is complete; (ii) designers may not have finished all of the design and specification work before awarding the contract and; (iii) changes in legislation and other external factors may force changes upon the project team. However, Asamaoh and Offei-Nyako (2013) affirm that there are many reasons that may cause the stakeholders to initiate variations during project administration.

Change in specifications, change of plans or scope and noncompliance design with government regulations are the main causes of variations in construction projects in Singapore (Arain, 2005). Client's financial problems, unexpected site conditions due to improper site investigation, lack of feasibility study at the proposed site and unavailability of equipment are among the causes of variations in the Malaysian construction projects (Mohammad et al., 2010). Likewise, impediment in prompt decision making process, replacement of materials and procedures by the clients, design discrepancies and inadequate working drawings by consultants are the causes of variations in the Seychelles construction industry (Sunday, 2010).

Relatively, inadequate project objectives by client and socio-cultural factors are cited as the potential causes of variations in construction phases in Ghana (Asamaoh and Offei-Nyako, 2013). Likewise, corrupt and fraudulent practices could be the potential sources of variations in the Tanzania construction industry (Mlinga, 2006). However, to overcome the problem of corrupt and fraudulent practice some governments have developed and implemented procedural guidelines on procurement of services, goods and works (Zou, 2006). Halwatura and Ranasinghe (2013) found that non-compliant design with government regulations, lack of coordination between consultant and contractor, conflicts between contract documents, lack of materials and equipment are the significant causes of variations that adversely affect construction projects in Sri Lanka.

Additionally, it is argued that lack of strategic planning by contractors plays a fundamental role in creating variations in construction projects (Zadeh et al., 2014; Msallam et al., 2015). Lokhande and Ahmed (2015) state that misinterpretation of contract documents, defective workmanship, financial difficulties by contractors, weather conditions, change in government regulations and economic conditions are the potential causes of variations in the construction industry of Yemen. Poor procurement process is reported by Fugar and Agyakwah-Baah (2010) as the potential cause of variations in construction projects in Ghana. Moreover, lack of judgment and experience is the factor of variations in construction projects in Kenya (Oloo et al., 2014). Thus, from syntheses of literature review, a total of 25 major factors that cause detrimental variations were identified and summarised in Table 1 with regard to their origin. Keane et al. (2010) further argue that the causes of variations could originate from client, consultant, contractor and non-party-related causes. The next section discusses research methods and data analysis techniques used for the study.

Table1. Causes of Detrimental Variations

Causes of Detrimental Variations	**References**
Client related causes	
Change of plans or scope	Arain (2005); Nachatar et al. (2010)
Client's financial problems	Memon et al. (2014)
Change in specifications	Mohammad et al. (2010)
Hindrance in prompt decision making	Sunday (2010); Memon et al. (2014)
Inadequate project objectives	Asamaoh and Offei-Nyako (2013)
Fraudulent and kickback practices	Mlinga (2006); Zou (2006)
Consultant related causes	
Design discrepancies	Sunday (2010)
Inadequate working drawings	Memon et al. (2014); Sunday (2010)
Differing site conditions	Mohamad et al. (2012)
Change in design/specifications	Memon et al. (2014)
Conflicts between contract documents	Halwatura and Ranasinghe (2013)
Lack of coordination	Lokhande and Ahmed (2015)
Poor procurement process	Fugar and Agyakwah-Baah (2010)
Lack of judgment and experience	Oloo et al. (2014)
Non-compliant design with government regulations	Halwatura and Ranasinge (2013)
Contractor related causes	
Misinterpretation of contract documents	Lokhande and Ahmed (2015)
Lack of strategic planning	Ubani et al. (2010)
Lack of judgment and experience	Mizanur et al. (2014)
Defective workmanship	Lokhande and Ahmed (2015)
Contractor's financial difficulties	Mohammad et al. (2010)
Unavailability of materials and equipment	Halwatura and Ranasinghe (2013)
External factors related causes	
Weather conditions	Lokhande and Ahmed (2015)
Change in economic conditions	Halwatura and Ranasinghe (2013)
Change in government regulations	Hwang and Low (2012)
Socio-cultural factors	Asamaoh and Offei-Nyako (2013)

3. Research Methodology

3.1 Research Design

There are five research styles: experiment, survey, action research, ethnographic research and case study (Alinaitwe et al., 2007). Ying (2009) considers that there are five common research strategies in the social sciences: surveys, experiments, histories, epidemiologic research and case studies. However, the adoption of the appropriate research design depends on the logic that links the data collected and data analysis to yield results that give answers to the main research questions being investigated. In this case, the survey method was adopted for the study. Fellows and Liu (2008) stipulate that surveys operate on the basis of statistical sampling; only extremely rarely are full population surveys possible, practical or desirable. Furthermore, Fellows and Liu (2008) clarify that, commonly, samples are surveyed through questionnaires or interviews. More specifically, the survey method using questionnaire was adopted for the study. It is argued that, the principles of statistical sampling – to secure a representative sample – are employed for economy and speed (Fellows and Liu, 2008). Evidently, interview approach is time-consuming, inconsistency and expensive in terms of cost as compared to questionnaire survey. Alshenqeeti (2014) reveals that interviews are time-consuming with regard to both data collection and analysis because they need to be transcribed, coded and possibly translated. As a result of limited resources in terms of cost and time, the study was designed to obtain views from architects, engineers, quantity surveyors and procurement officers with regard to detrimental variations in public building projects using a questionnaire survey. Impliedly, a quantitative research was conducted for the collection of numerical data that were interpreted, analysed and explained statistically.

3.2 Study Population

Population of the study comprised of engineers registered by Engineers Registration Board (ERB), architects and quantity surveyors registered by Architects and Quantity Surveyors Registration Board (AQRB) and, procurement and supplies officers registered by Procurement and Supplies Professionals and Technicians Board (PSPTB) in Tanzania. In the case of Uganda, questionnaire survey was administered to practicing professionals

registered by Uganda Engineers Registration Board (ERB), Surveyors' Registration Board of Uganda (SRBU), Architects Registration Board of Uganda (ARB) and the Institute of Procurement Professionals of Uganda (IPPU).

3.3 Questionnaire Design

Questionnaire form was divided into two main sections. On one hand, the respondent was asked to fill in the space provided with the appropriate respondent's general information. On the other hand, the respondent was asked to rate causes of variation variables using five-point Likert scale viz-a-viz: strongly disagree = 1; disagree = 2; neutral = 3; agree = 4 and strongly agree = 5. Likert Scale Rating System (LSRS) has been used successfully by many researchers such as Mohammad et al. (2010) and Mizanur et al. (2014) in their studies.

3.4 Pilot Study

Pilot study was conducted to find out if the questionnaire was able to measure what was supposed to be measured; the wording was clear; if all questions were interpreted in the same way by respondents; what responses were provided; and if there was any research bias. It is argued that, to ensure the effectiveness of a questionnaire, a pre-test should be carried out by piloting the questionnaire with a small representative sample (Kombo and Tromp, 2006). Furthermore, a pilot study helps to refine data collection plans with respect to both the content of the data and the procedure to be followed (Yin, 2009). Therefore, a judgment sample of 18 respondents with good spread of respondent characteristics was chosen for the preliminary testing of the questionnaire. The questionnaires were administered to professionals (architects, engineers, quantity surveyors and procurement officers) contacted in person. Nevertheless, only 9 respondents were able to return the filled questionnaire forms. Based on their feedback, corrections were made to improve the format, layout, questions and the overall content of the questionnaire. Through this process, the questionnaire was validated and provided the authors with improvement opportunity prior to main survey.

3.5 Sampling Technique

Given the wide distribution of public building projects and their heterogeneous nature around Tanzania and Uganda, the purposive sampling method was used in this study. Purposive sampling involves searching for cases or individuals who meet a certain criterion (Palys, 2008). Also, researchers' sample must be tied to their objectives (Palys, 2008). It is argued that, purposeful sampling is a technique widely used in research for the identification and selection of information-rich cases for the most effective use of limited resources (Palinkas et al., 2015). Moreover, purposive sampling technique, also called judgment sampling, is a deliberate choice of an informant due to the qualities that the informant possesses (Tongco, 2007).

3.6 Sample Size and Selection

The primary data for this study were collected from multiple construction professionals around Tanzania (TZ) and Uganda (UG). In the case of Tanzania, a total of 183 questionnaire forms were purposively administered to 36 architects, 90 engineers, 42 quantity surveyors and 15 procurement officers contacted in person to get individual's perceptions. On the side of Uganda, a total of 52 questionnaire forms were purposively distributed to 9 architects, 24 engineers, 14 quantity surveyors and 5 procurement officers for the same. Telephone call and Short Message System (SMS) reminders were used to remind the respondent to fill the questionnaire form. Results in Table 2 illustrate that 143 and 34 valid responses from Tanzania and Uganda were received from the respondents constituting 78 percent and 65.4 percent of responses respectively which were considered adequate for data analysis.

3.7 Data Analysis

Data analysis was done with the help of the Statistical Package for Social Sciences (SPSS) version 17. The data collected from the questionnaire survey were coded and entered into the SPSS computer software program that analyzed statistically all the required statistics such as frequencies, Cronbach's alpha reliability test, mean, standard deviations and t-test to draw inferences. Statistics such as variances and coefficient of variations of the participants' evaluations of the factors causing detrimental variations in building projects were then calculated as shown in the equations 1, 2 and 3 respectively:

$$E(x) = \sum_{i=1}^{n} x_i p(x_i) \quad (1)$$

$$V(x) = E\left(X - \mu\right)^2 \quad (2)$$

$$COV\ (x) = \frac{\sqrt{V(x)}}{E(x)} \quad (3)$$

Where E(x) is the expected value of a discrete random variable X, x are the values of the random variable for which p(x) > 0, p(x) is the probability distribution, μ is the mean, V(x) is the variance of random variable X, and COV(x) is the coefficient of variation. Based on the evaluation of the causes of detrimental variations in each country of Tanzania and Uganda, the factors were ranked by their respective coefficient of variations. Ranking by COV has been employed before and is considered reliable because it considers both E(x) and V(x) values. Many researchers such Alinaitwe and Ayesiga (2013) and Mahamid and Dmaidi (2013) have successfully used COV for ranking in their studies.

Table 2. Distribution of the Respondents

Reg. Board-TZ/UG	Category of Participants	Questionnaires Sent		No. of Response		Response Rate (%)	
		TZ	UG	TZ	UG	TZ	UG
AQRB/ARB	Architects	36	9	12	3	33.3	33.3
ERB	Engineers	90	24	84	23	93.3	95.8
AQRB/ ISU	Quantity surveyors	42	14	35	7	83.3	50
PSPTB/ IPPU	Procurement officers	15	5	12	1	80.00	20.0
	Total	183	52	143	34	78	65.4

4. Results and Discussion

4.1 Respondents' Characteristics

Respondents were categorised in terms of their work experiences and respective parties. Results in Table 3 indicate that in Tanzania the majority of the respondents about 55 percent were from clients. This has made this study worthwhile because the study was on public building projects. However, in the case of Uganda, about 91 percent of the respondents were from contractors. The determined average of 15 and 10 years of work experiences of respondents from Tanzania and Uganda respectively was considered suitable such that, the responses given by those professionals were considered reliable and trustworthy.

Table 3. Demographic of Respondents

Characteristics	Frequency		Percentage (%)		Cumulative Percentage (%)	
	Tanzania	Uganda	Tanzania	Uganda	Tanzania	Uganda
Type of organisation						
Client	79	2	55	6	55	6
Consultant	39	1	27	3	87	9
Contractor	25	31	18	91	100	100
Total	143	34	100	100		
Work experience						
0 – 5 years	43	6	30	17.6	30	17.6
6 – 10 years	37	17	26	50	56	67.6
11 – 15 years	19	6	13	17.6	69	85.2
16 – 20 years	17	3	12	8.8	81	94
21 – 25 years	9	0	6	0	87	94
More than 25 years	18	2	13	6	100	100
Total	143	34	100	100		

4.2 Reliability Testing

Reliability testing of the questionnaire was carried out to determine whether the questionnaire was capable of yielding similar scores if the respondents used it twice. SPSS version 17 was used to compute Cronbach's alpha coefficient value for all rated 25 items in the questionnaire. Zadeh et al. (2014) affirm that the Cronbach's alpha coefficient value is usually computed from the following formula:

$$Alpha = \frac{NC}{V + (N - 1) * C} \quad (4)$$

Where N = the number of items, V = the average variance and C = the average inter-item covariance. Reynolds and Santos specify that an alpha value greater than 0.7 implies that the instrument is acceptable (Alinaitwe et al., 2014). The determined Cronbach's alpha coefficient value for the rated 25 items of the questionnaire was 0.857. This value indicates that the items form a scale that has reasonable internal consistency reliability. Impliedly, the survey instrument used was reliable and acceptable and that an agreement exists between construction industry practitioners in rating the factors of detrimental variations accordingly.

4.3 Client Related Causes of Variations

From Table 4 it is clear that there was a slight different in ranking the causes of variations in those two countries of Uganda and Tanzania. This was not completely unexpected because each country has different setup and challenges in her construction industry. However, factors such as change on plans or scope, change in specifications, client's financial problems and hindrance in prompt decision making appear to be the most four critical factors of all six rankings. Evidently, these factors can indeed be accepted as the most important causes of variation related to clients in both countries of Tanzania and Uganda. These results suggest that much interaction between the design team and client is needed to ensure that client's requirements are clarified and communicated effectively to reduce non-compliance design with client's requirements. Ismail et al. (2012) and Sunday (2010) affirm that change of plans or scope by clients is a factor that contributes mostly to the causes of variations in the construction of Iran and Seychelles respectively. Furthermore, Arain (2005) insist that change in specifications, change of plans or scope are the main causes of variations in construction projects in Singapore. Memon et al. (2014) found that client's financial problem is the common factor of variations in the Malaysian construction projects. However, Client's financial problem was ranked second in both countries. This implies that, due to various reasons most clients fail to release funds on time with the consequence of cost and time overruns in construction projects. The rest ranked factors were also identified in other countries such as hindrance in prompt decision making (Sunday, 2010) in the Seychelles construction industry and inadequate project objectives (Asamaoh and Offei-Nyako, 2013) in Ghana. However, the lowest ranked causes of variations were fraudulent and kickback practices (COV = 0.394) in Tanzania and inadequate project objectives (COV = 0.336) in Uganda respectively. Basically, respondents in both countries have agreed that all factors with E(x) values greater than 3 were the significant causes of detrimental variations related to clients.

4.4 Consultant Related Causes of Variations

Results in Table 4 demonstrate that design discrepancies (COV = 0.201) and differing site conditions (COV = 0.215) were ranked 1st and 2nd respectively in Tanzania. In the case of Uganda, design discrepancies (COV = 0.229) and lack of coordination (COV = 0.230) were ranked 1st and 2nd respectively. Despite the slight different in ranking the causes of variations, factors such as design discrepancies, differing site conditions, change in design or specifications, in adequate working drawings and lack of coordination were seen as the most five important causes of variations related to consultant in both countries of Uganda and Tanzania. Impliedly, these factors can indeed be accepted as the most important causes of variation related to consultant in both countries. Design discrepancies can be caused by various factors including the inability of the design team to accommodate the project requirements from the client and other stakeholders. Asad and Khalfan (2007) assert that conceptualizing design and construction process from recognition of a project need to the operation stage ensures informed decision-making at the front end of design and construction development process. The rest ranked factors as identified in other countries were differing site conditions (Mohammad et al., 2010) in Malaysia; change in specifications (Arain, 2005) in Singapore; non-compliant design with government regulations, lack of coordination and conflicts between contract documents (Halwatura and Ranasinghe, 2013) in Sri Lanka; poor procurement process (Fugar and Agyakwah-Baah, 2010) in Ghana and lack of judgment and experience (Oloo et al, 2014) in Kenya. Furthermore, Ndihokubwayo and Haupt (2009) claim that 18 percent out of 47 percent of the variations related to consultant was contributed by lack of detailed drawings. In fact, lack of detailed drawings

can be caused by several factors including consultant's lack of judgement and experience in design. The least ranked causes of variations were poor procurement process (COV = 0.357) in Tanzania and lack of judgement and experience (COV = 0.333) in Uganda respectively. Overall, respondents in both countries have agreed that all factors with E(x) values greater than 3 were the significant causes of detrimental variations related to consultants.

4.5 Contractor Related Causes of Variations

Results from Table 4 indicate that lack of judgement and experience and lack of strategic planning were ranked 1st and 2nd in Tanzania and Uganda respectively. Impliedly, these factors were the foremost critical factors of variations related to contractor in both countries. However, there was a slight difference in ranking the rest factors between the two countries. As enlightened before, this was not completely unexpected because each country has different setup and challenges in her construction industry. In fact, contractor related causes of variations were also identified in other countries such as lack of strategic planning (Zadeh et al., 2014) in Canada; lack of judgment and experience (Oloo et al, 2014) in Kenya; unavailability of materials and equipment (Halwatura and Ranasinghe, 2013) in Sri Lanka; defective workmanship and financial difficulties (Lokhande and Ahmed, 2015) in Yemen. Furthermore, Asamaoh and Offei-Nyako (2013) argue that in order to convey a complete concept of the project design, the working drawings must be clear and concise. It is further argued that a delay due to misinterpretation in one of the contracts would cause disruptions in other contracts schedule (Lokhande and Ahmed, 2015). Nevertheless, the lowest ranked causes of variations were contractor's financial difficulties (COV = 0.409) in Tanzania and misinterpretation of contract documents (COV = 0.542) in Uganda respectively. However, contrary to the participants in Uganda, participants in Tanzania agreed that all related contractor's factors of detrimental variations were significant since their E(x) values were greater than 3. Presumably, the reason is that, as illustrated in Table 3, about 91 percent of the participants in Uganda were from contractors.

4.6 External Factors Related Causes

Results in Table 4 indicate that weather conditions (COV = 0.198) was ranked 1st, change in economic conditions (COV = 0.267) ranked 2nd and socio-cultural factors (COV = 0,281) ranked 3rd respectively in Tanzania. Relatively, change in economic conditions (COV = 0.247) was ranked 1st, socio-cultural factors (COV = 0.269) ranked 2nd and weather conditions (COV = 0.302) ranked 3rd respectively in Uganda. However, change in government regulations was ranked 4th in both countries. Despite the similarities and dissimilarities in ranking, respondents in both countries have agreed that all external related factors were the significant causes of variations in public building projects since their E(x) values were greater than 3. Certainly, previous studies found these external factors of variations as detrimental to building projects. It is argued that changing weather conditions such as rain, snow, wind, and adverse temperature conditions have serious negative impacts on productivity resulting into delays in construction and variations in the schedule (Lokhande and Ahmed, 2015). Mohammad et al. (2010) insist that, weather changes are the cause of variations that are not directly related to the project participants. Change in economic conditions and change in government regulations were also observed by Halwatura and Ranasinghe (2013) in Sri Lanka. Furthermore, Asamaoh and Offei-Nyako (2013) reveal that in the Ghanaian construction industry socio-cultural factor is one of the causes of variation with less impact. Presumably, most construction industries in developing countries are characterized by both local and foreign firms whereby professionals with different socio-cultural backgrounds work together and encounter a number of problems due to different perceptions and language barriers. This situation may cause lack of coordination and communication between professionals in the construction project working environment, leading to reworks and delays.

Table 4. Statistical Analysis for Ranking Causes of Detrimental Variations

Causes of Variations	TANZANIA N = 143				UGANDA N = 34			
	E(x)	$\sqrt{V(x)}$	COV	Rank	E(x)	$\sqrt{V(x)}$	COV	Rank
Client related causes								
Change of plans or scope	4.1678	0.9268	0.222	1	3.7647	1.0462	0.278	4
Change in specifications	3.8671	1.1459	0.296	2	3.7353	0.8637	0.212	1
Client 's financial problems	3.9091	1.2385	0.317	3	3.7647	0.9231	0.245	2
Hindrance in prompt decision making	3.6084	1.1751	0.326	4	3.6471	0.9497	0.260	3
Inadequate project objectives	3.2308	1.1549	0.357	5	2.9706	0.9996	0.336	6
Fraudulent and kickback practices	3.0490	1.2005	0.394	6	3.2059	1.0668	0.333	5
Consultant related causes								
Design discrepancies	4.0699	0.8192	0.201	1	3.5882	0.8209	0.229	1
Differing site conditions	4.0140	0.8639	0.215	2	3.5882	1.0185	0.284	5
Change in design/specifications	3.9231	1.0145	0.259	3	4.0000	0.9847	0.246	4
Inadequate working drawings	4.0350	1.0708	0.265	4	3.7941	0.8801	0.232	3
Lack of coordination	3.4545	0.9548	0.276	5	3.4118	0.7831	0.230	2
Conflicts between contract documents	3.5524	1.0048	0.283	6	3.1471	0.9255	0.294	6
Non-compliant design with government rules	3.1329	1.0631	0.339	7	3.4706	1.0513	0.303	7
Lack of judgment and experience	3.1958	1.1275	0.353	8	3.6176	1.2064	0.333	9
Poor procurement process	3.2378	1.1565	0.357	9	3.2647	1.0534	0.323	8
Contractor related causes								
Lack of judgment and experience	3.5315	1.0734	0.304	1	2.9706	1.1930	0.402	1
Lack of strategic planning	3.5664	1.1042	0.310	2	2.7353	1.1628	0.425	2
Misinterpretation of contract documents	3.6014	1.1757	0.326	3	2.7353	1.4834	0.542	6
Defective workmanship	3.3986	1.1757	0.346	4	2.6765	1.2240	0.457	4
Unavailability of materials and equipment	3.2937	1.1678	0.355	5	2.8824	1.2972	0.450	3
Contractor's financial difficulties	3.3497	1.3610	0.409	6	2.7353	1.3328	0.487	5
External related causes								
Weather conditions	4.0140	0.7960	0.198	1	4.0294	1.2182	0.302	3
Change in economic conditions	3.9231	1.0487	0.267	2	3.9118	0.9651	0.247	1
Socio-cultural factors	3.2937	0.9256	0.281	3	3.4412	0.9274	0.269	2
Change in government regulations	3.4406	1.1046	0.321	4	3.2647	1.0242	0.314	4

4.7 One Sample t-test

One sample t-test was carried out using SPSS software version 17 to test for the significance of the ratings. The test value was set as 3 because the rating scale ranges from 1 to 5 with 3 being a neutral position. Results in Tables 5 show that in Tanzania about 92 percent of the causes of variation variables demonstrated significant values less than 0.05. Impliedly, the differences in means were statistically significant at the 0.05 confidence level. However, about 8 percent of the variables demonstrated significant values higher than 0.05 suggesting that the differences in means were statistically not significant at the 0.05 confidence level. In the case of Uganda, about 56 percent of the causes of variation variables demonstrated significant values less than 0.05. Impliedly, the differences in means were statistically significant at the 0.05 confidence level. Nevertheless, about 44 percent of the causes of variation variables demonstrated significant values higher than 0.05 signifying that the differences in means were statistically not significant at the 0.05 confidence level. The t values in both countries demonstrated that the rating of the factors was significant since they are above or below zero. Relatively, the 95% interval of difference ($\rho = 0.05$) shows that all rated factors have both the upper and lower limits above or below zero meaning that they were practically significant.

Table 5. One Sample t-test for Attributes of Detrimental Variations

	TANZANIA		UGANDA	
	N = 143 df = 142 Test value = 3		N = 34 df = 33 Test value = 3	
Causes of Variations	**t**	**Sig.**	**t**	**Sig.**
Client related causes				
Change of plans or scope	15.068	0.000	4.262	0.000
Change in specifications	9.049	0.000	4.831	0.000
Client 's financial problems	8.778	0.000	4.964	0.000
Hindrance in prompt decision making	6.191	0.000	3.973	0.000
Inadequate project objectives	2.390	0.018	-0.172	0.865
Fraudulent and kickback practices	0.488	0.627	1.125	0.269
Consultant related causes				
Design discrepancies	15.618	0.000	4.179	0.000
Differing site conditions	14.036	0.000	5.921	0.000
Change in design/specifications	10.880	0.000	5.262	0.000
Inadequate working drawings	11.558	0.000	3.368	0.002
Lack of coordination	5.693	0.000	0.927	0.361
Conflicts between contract documents	6.575	0.000	3.066	0.004
Non-compliant design with government regulations	1.495	0.137	1.465	0.152
Lack of judgment and experience	2.077	0.040	2.985	0.005
Poor procurement process	2.459	0.015	2.610	0.014
Contractor related causes				
Lack of judgment and experience	2.077	0.040	-1.040	0.306
Lack of strategic planning	6.135	0.000	-1.327	0.193
Misinterpretation of contract documents	6.117	0.000	-0.144	0.887
Defective workmanship	4.054	0.000	-1.541	0.133
Unavailability of materials and equipment	3.007	0.003	-1.158	0.255
Contractor's financial difficulties	3.052	0.003	-0.529	0.600
External factors related causes				
Weather conditions	15.233	0.000	4.927	0.000
Change in economic conditions	10.526	0.000	5.509	0.000
Socio-cultural factors	3.794	0.000	1.507	0.141
Change in government regulations	4.770	0.000	2.774	0.009

5. Conclusions and Recommendations

5.1 Conclusions

The study findings demonstrated that public building projects suffered because of the detrimental variations. Based on the research objectives, the significant causes of detrimental variations in public building projects were identified, evaluated and ranked. Factors such as change on plans or scope, change in specifications, client financial problem and hindrance in prompt decision making appear to be the most four critical client related factors of variations in public building projects. Certainly, these factors can indeed be accepted as the most important causes of detrimental variation related to clients in both countries of Tanzania and Uganda. Relatively, despite the slight different in ranking, factors such as design discrepancies, differing site conditions, change in design or specifications, in adequate working drawings and lack of coordination were seen as the most five important causes of detrimental variations related to consultant in both countries of Uganda and Tanzania. In the category of contractor related causes, lack of judgement and experience and, lack of strategic planning were ranked 1st and 2nd in Tanzania and Uganda respectively. Impliedly, these factors were the foremost critical factors of variations related to contractor in both countries. In this case, there is need for contractors to undergo specific training related to contract and project management issues. Training could help to improve contractors' performance and hence reduce detrimental variations related to contractors.

Furthermore, it is observed that weather conditions, change in economic conditions, socio-cultural factors and change in government regulations were the significant causes of variations in public building projects in both countries. Therefore, it is important for the project parties to highly consider and understand these factors before implementing any project. This could help to lessen the negative impacts of variations related to external factors in the performance of construction project. The t-test analysis was used to determine the significance of ratings.

In fact, from the test results, it can be inferred that, the ratings of the causes of detrimental variation variables were significant. This implies that the agreement among respondents in rating and ranking the factors of variations was significant. The study findings can be integrated into both countries of Tanzania and Uganda, and other developing countries of the world to improve construction performance. Furthermore, the study findings could provide useful insights in engendering managerial efficiencies and effectiveness towards successfully improvement of construction performance. The findings of this study should inform the professionals, policy makers, academicians and researchers to improve performance of building projects. Likewise, findings of this study could be used as input for future studies.

5.2 Recommendations

Based on the study findings, the researchers recommend the following: team work spirit among project parties, proper procurement of consultants and contractors, proper feasibility study of the project, sufficient time for design, inclusive design, and proper change control mechanisms would be beneficial and effective ways of mitigating detrimental variations in public building projects.

6. Research Limitations

Although this research work has generated important findings related to construction performance theory and practice, its design is not without flaws. Based on the limitation of the sample size of 183 and 52 professionals in Tanzania and Uganda respectively, future research should employ a large number of respondents. In addition to quantitative technique, a qualitative study of the causes of variations should be performed. This could help to maximize the strengths and minimize the limitations of each technique (Kombo and Tromp, 2006). Moreover, discussion of other relevant causes of detrimental variations in construction projects is beyond the scope of this study.

7. Contributions

Overall, results of this study should help to monitor the trends of detrimental variations in public building projects. Remarkably, one of the main contributions of this study lies in the fact that, it was able to identify ordered grouped sets of causes of the detrimental variations in public building projects in Tanzania and Uganda respectively. Another significant contribution of this study is that, it sheds light and provides insights on the understanding of the detrimental variations affecting the performance of public building projects within the Tanzanian and Ugandan construction sectors respectively. It also expands the efforts of studying and evaluating causes of detrimental variations across the world and particularly in developing countries, including the context of the East African Community (EAC). Furthermore, one notable contribution of this study is that, it extends and builds upon previous researchers' works such as Kassim and Long (2007) who acknowledged that, so far few formal studies have been carried out to analyse the causes and effects of variations in construction projects. Hence, this study makes a contribution to fill that lacunae and heed Kassim and Long (2007) plea for pioneers to carry extensive study on the effects of variations in construction projects. Moreover, the study provides insights on the potential causes of detrimental variations in public building projects across Tanzania and Uganda construction sectors respectively, involving more stakeholders such as clients, consultants, contractors in additional to the practicing professionals.

8. Future Research

As mentioned earlier, findings of this study could be used as input for future studies. Specifically, further research could focus on developing effective mitigation measures to alleviate the detrimental variations in public building projects. Mitigation measures could help policy makers, academicians and professionals of the construction industry to curb the persisting deleterious variations in building projects and improve performance of construction.

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